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OF THE

TORREY BOTANICAL CLUB

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BULLETIN

OF THE

TORREY BOTANICAL CLUB

SEPTEMBER, 1923

The altitudinal distribution of plants on Mt. Gedeh, Java*

WILLIAM SEIFRIZ

(WITH PLATES 15–17 AND SEVEN TEXT FIGURES)

Mt. Gedeh is in the "Preanger Regent" of western Java. At its foot lies the village of Singdanglaja, some five hours'

FIG. 1. Mt. Pangerango from Gedeh. The slope of Pangerango makes clear how rapid a change in altitude plants have to contend with. Water covered rice fields can be faintly seen in the valley just over the lower edge of Pangerango.

journey by rail and coach from Buitenzorg. Gedeh, with Pangerango, the "princely mountain," and Sela, form a trio of volcanic mountain peaks. Of these Gedeh alone is semi-active. It was last in eruption in 1899. At present the hot springs gush-

* Contribution from the Osborn Botanical Laboratory.

[The BULLETIN for August (**50**: 261–282) was issued August 17, 1923.]

ing from the mountain side and the several fumaroles in the crater emitting fumes of sulphur are the only indications that Mt. Gedeh is a volcano in the dormant state. Mt. Pangerango (FIG. 1), whose beautiful conical form commands admiration, and Mt. Sela are both extinct. The botanical explorations described on the following pages refer primarily to Mt. Gedeh, though some mention is made of plants of interest found on the two neighboring peaks.

FIG. 2. The superb rasamala, *Altingia excelsa*. This tree (in the center background) is 150 feet high. Note the straight uniform trunk. The tree-fern is an *Alsophila*, 42 feet high.

Midway up the slope of Mt. Gedeh is the government experimental station of Tjibodas ("white river"). The laboratory, cottage, and garden at Tjibodas serve as a base for botanical excursions into the mountain forests beyond. The Tjibodas Garden contains numerous interesting plants, notably the renowned grass trees, *Xanthorrhoea Preissii* (PLATE 15, FIG. 1). These liliaceous trees are natives of the Australian savannahs. The twin specimens in the Tjibodas Garden are familiar to botanists through the illustration in Haberlandt's "Botanische Tropenreise." The trees have doubled in size since Haberlandt saw them thirty years ago.

Back of Tjibodas, extending to the summits of Mts. Gedeh, Pangerango, and Sela, is a virgin forest of supreme beauty, with a flora unsurpassed, if indeed it is approached, by that of any other similar region in the world. One of the most striking feat-

ures of plant life in this mountain rain-forest is the marked change in type of vegetation as one ascends. At Tjibodas, at an altitude of 4,600 feet, the palms, bamboos, fig trees, and bananas, characteristic of the lowlands, still occur, but are soon displaced by oaks, chestnuts, *Podocarpus* and tree-ferns. Gnarled, moss-covered trees then follow, only later to disappear. And finally, after attaining an altitude of 9,400 feet, a scant alpine flora, characterized by the Javanese edelweiss, is reached.

The following brief description of the altitudinal distribution of plants in the virgin forest on Mt. Gedeh will, I trust, give some idea of the distribution of the plant life and of its luxuriance and beauty.

Java was divided into four "Gewächszonen" by Junghuhn, the foremost naturalist of the Dutch East Indies, and these vegetative zones he divided into "Gebiete." The first zone of Junghuhn is the hot region from the sea-coast to an altitude of 2,000 feet; the second, the temperate region from 2,000 to 4,500 feet; the third, the cool region from 4,500 to 7,500 feet; and the fourth, the cold region from 7,500 to 10,000 feet. These last two vegetative zones of Junghuhn, from 4,600 feet, the altitude of Tjibodas, to 9,400 feet, the crater of Mt. Gedeh,* which are the ones that concern us here, can be divided into five distinct subzones.

I. THE RASAMALA SUBZONE

(4,600–5,500 feet)

The first subzone, at Tjibodas, is characterized by its big trees—superb giants many of them are. The monarch of all is the rasamala, *Altingia excelsa* (*Liquidambar Altingiana*) (FIG. 2), whose smooth, grayish white trunk arises out of the wealth of vegetation at its base as straight as a ship's mast. These fine trees reach a height of 175 feet and a maximum diameter, near the base, of 8 feet (FIG. 3). When buttresses are formed the base may flare to a diameter of 12 feet. The trunk maintains a diameter of fully 2½ feet for 75 to 100 feet from the ground at which point it first branches. So characteristic a tree of this region is *Altingia* that it may well lend its name to the subzone.

* The summit of Mt. Pangerango is 9,800 feet.

The rivals of the rasamala in size are the oaks and chestnuts. The oaks, of which there are several species (e.g., *Quercus spicata* and *Q. Pseudo-molucca*), are in some respects strikingly different from our American oaks. The trunks rise like great columns before they branch to form the crown, and the fruits are of a colossal size compared to an American acorn. Botanists do not always appreciate how characteristic a tree of the tropics the oak is. We become accustomed to regarding *Quercus* as a temperate genus. The chestnuts are likewise of great size. The two characteristic species are *Castanea Tungurrut* and *C. argentea*.

FIG. 3. The trunk-base of the rasamala. The large liane (on the left), marked with successive rings, is a *Piper*, possibly *P. baccatum*. The smaller liane, extending up the trunk, is *Ficus disticha*. The large leaves of a banana, *Musa acuminata*, can be seen in the lower right corner.

Conspicuous among the big trees of the first subzone on Mt. Gedeh are the figs, whose composite trunks assume tremendous size. There are nine species of fig on Gedeh (more than sixty in all Java), the largest of which is *Ficus involucrata*. In connection with the epiphytic habit of fig tree seedlings it is of interest to note that Chodat,* as a result of his recent investigations in South America, has discovered that "the young *Ficus* from its first implantation behaves as a *saprophyte*."

The medium sized and smaller trees of the first subzone are

* Chodat, Robert: La Végétation du Paraguay, Geneva, 1920.

of many kinds. There are numerous species of *Eugenia* and *Litsea*, three of *Viburnum*, two of *Turpinia*, and one each of *Euonymus* (*E. javanicus*), *Ilex* (*I. spicata*), and *Olea* (*O. javanica*). The small tree *Pithecolobium montanum* is one of the few Leguminosae to be found in these mountain forests. We shall meet a second tree member of this family on the very summit of Gedeh. Another tree of this and the second subzone which is worthy of special note is *Vernonia arborea*. This tree is one of the Compositae, yet it may be 80 feet high and 2½ feet in diameter (FIG. 4).

FIG. 4. The trunk of *Vernonia arborea*. This 80 foot tree is one of the Compositae.

The fig, *Ficus Ribes*, is an interesting small tree because it affords a striking example of a rather common fruiting habit among tropical trees, namely, cauliflory. *Saurauja* (*S. pendula*, *S. nudiflora*, and five other species), whose white flowers with thick, waxy petals are often seen strewn over the path, is an example of incomplete cauliflory. The flowers are borne not only on the surface of the tree trunk and larger limbs but at the tips of slender twigs as well. Such a semi-cauliflory characterizes several other Javanese trees.

The foregoing list of first subzone trees is very incomplete and gives at best but a number of representative species. Of trees alone there are nearly two hundred species on Mt. Gedeh; of shrubs and herbs over three hundred and fifty species; and of lianes some sixty or more, totaling at least six hundred species of plants exclusive of the ferns, mosses and fungi.

Lianes are numerous in the first subzone. The family Vitaceae is well represented among the smaller climbers

The slender and warty vine, *Vitis papillosa*, is of interest because of its multitude of aerial roots which often swing clear for fifty feet or more from the crown of some huge tree and present a striking picture when one comes upon a barricade of them lighted up by the sun. *Smilax odoratissima* is the catbrier of these forests. *Agalmyla parasitica* (which is *not* parasitic) is an interesting epiphytic climber frequently met with. The tubular flowers are of a brilliant scarlet with long protruding stamens of purple. The leaves of this vine when in the cool of the shade project outward perpendicularly to the support, but droop once the sun strikes them. The petioles and leaves are thick, succulent, and turgid, suggesting the mechanism by which the raising and lowering of the leaves is accomplished. Another creeper found frequently upon the trunks of trees is the aroid, *Scindapsus hederaceus*, readily distinguished by its broad, winged petioles. This vine and its sister genus *Rhaphidophora* are the only two climbing Araceae found in any great abundance in the mountain rain-forest. Among the large lianes are *Uncaria* and *Embelia* (*E. pergamacea*), the latter often attaining great length (as much as 250 feet).

So numerous are the plants that make up the undergrowth of the first subzone that it is an almost hopeless task to attempt to give a representative list of them. A single bamboo, *Dinochloa scandens*, is still to be found at this altitude. Of the many palms which characterize the tropical vegetation of Java as a whole, but three comparatively inconspicuous genera occur in the mountain forest. These are the slender and graceful *Pinanga Kuhlii* and the two rattan palms, *Calamus* and *Plectocomia* (*P. elongata*). The two latter genera are climbing palms with long extended leaf rhachides armed with vicious recurved thorns by means of which the plants often attain a height of 75 feet or more, thus reaching up into the second story of the forest. One of the Pandanaceae, *Pandanus Lais*, is very common in the undergrowth of the first subzone.

Showy flowers are much more abundant at Tjibodas than is usually the case in a tropical rain-forest, although less frequent in the forest interior. They seek the bright areas along the trail and the open formations of the higher zones. In the closed formation of the first subzone the most striking flower is that of the ginger, *Amomum*. Its brilliant scarlet blossom is often

found protruding from the ground, growing quite alone in the very center of the trail. Dense thickets are formed by the rank growth of the tall vegetative shoots of this plant. Associated with this ginger is another species, *Phaeomeria solaris*, whose flower also appears just above the surface of the soil some distance from the leafy shoots of the plant The blossom is of a rich orange-red color and as large as a small head of cabbage. Other but terminal-flowered gingers will be met with in the next subzone. The blossom of *Arisaema filiforme* (a jack-in-the-pulpit) is an attractive though somber colored flower, especially interesting because of its unusually long spadix which droops out of the spathe to a length of eight inches. The three jaunty bells of the tiny weed, *Argostemma montanum*, form a dainty white flower cluster which is abundant along the trail. *Cestrum elegans* is a small tree-shrub with red pendent flowers.

Of the phanerogamous epiphytes the orchids are the most numerous. Those most frequently met with are species of *Dendrobium* and *Bulbophyllum*. *Liparis*, *Eria*, and *Appendicula* are somewhat less numerous, although *A. ramosa* is rather abundant. Certain species of *Dendrobium* are remarkable because all the individuals in any one locality blossom simultaneously.* The epiphytic "pines," *Tillandsia* and *Caruguata*, which are so striking and characteristic a feature of the epiphytic vegetation of tropical America, are not to be found in Java—indeed, not in all the eastern tropics.

Ferns, both as part of the vegetation of the forest floor and as epiphytes are exceedingly abundant. The ferns as a group are widely distributed throughout the mountain rain-forest, occurring in all subzones, though in varying abundance. Common terrestrial forms of the first subzone are, *Pteridium aquilinum*, *Pteris longipes*, numerous species of *Dryopteris* (e.g., *D. truncata*), and the interesting *Diplazium proliferum*, which develops a bud, often of huge size, at the base of each pinna. This habit of proliferating is not infrequent among the ferns of this region.

A noteworthy fern is the enormous *Angiopteris evecta*, found in moist spots, especially bordering streams, and occurring in many forms. This fern commands attention because of its colossal 15–18 foot fronds which spread out over the trail.

* See Seifriz, William: The gregarious flowering of the orchid *Dendrobium crumenatum*. Am. Jour. Bot. **20**: 32–37. 1923.

Another interesting fern is the stout *Polypodium Feei*, with its mass of prominent sori completely covering the back of a fertile frond. It grows in great profusion among the rocks near the base of waterfalls. A variety of this same fern—a most adaptable and widely distributed species—is again found on the dry lava floor of the crater of Mt. Gedeh.

Tree-ferns are infrequently met with along the trail in the lower subzones. They seek the more open forest formations at higher altitudes or the sunny yet moist ravines.

The epiphytic ferns with the tree-ferns distinguish a tropical fern flora from a temperate one. The characteristic epiphytic fern of the first subzone on Mt. Gedeh is the magnificent bird's nest fern, *Asplenium nidus* (PLATE 15, FIG. 2). This huge fern, with a spread of sometimes as much as 15 feet, may be seen perched like a large bird with out-spread wings, upon a small limb far out in space, or it may be found near the ground completely encircling a tree trunk, then resembling a fancy flower basket. Occasionally one is seen apparently floating free in the air, and only on close examination is the bent slender twig supporting it discovered (PLATE 16, FIG. 1).

The nest shape of *Asplenium nidus* forms an ideal catch-all for falling leaves and detritus, a natural basket always full of rich organic matter. This fine substratum in turn supports yet other epiphytic ferns. Some of these are of very good size, such as *Stenolepsis tristis* and *Nephrolepsis acuminata*, with fronds often 6–8 feet in length (PLATE 16, FIG. 1). This latter fern is one of the most graceful in the forest.

While *Asplenium nidus* is the characteristic fern and epiphyte of the first subzone, other epiphytic ferns are numerous. Chief among these is *Polypodium Heracleum*, a rival in size though not in abundance of *Asplenium nidus*. The large, deeply cleft fronds of the *Polypodium*, measuring as much as 7 feet in length and 18 inches in width, surround a tree very much as does the bird's nest fern. This remarkable genus is the only one which has representative species in all the subzones, from Tjibodas to the crater of Gedeh.

The long grass-like fern *Vittaria elongata* drapes the trees and lianes in an attractive manner (FIG. 3). Several polypodiums, e.g., *P. obliquatum*, are common as epiphytes. And one should not neglect the less conspicuous but beautiful and

delicate little filmy ferns, species of *Hymenophyllum* and *Trichomanes*. The smallest of the hymenophyllums we shall find at a higher altitude.

Mosses exist, but are to be found in much greater abundance in the second and fourth subzones. Species of liverworts are not numerous, although fine patches of the large *Dumortiera hirsuta* are frequent.

Fungi (with conspicuous fruits) are seldom met with. This is rather generally true of the tropics. A few species of the woody and leathery forms of the Polyporaceae and an occasional gill fungus are all that are superficially evident. Diligent search does, however, reveal other and interesting species, often of brilliant color.

Of lichens the number of species is exceedingly great. I have seen trunks of the great rasamala completely covered with encrusting lichens which give to the tree the appearance of an elaborate mosaic. The Graphidae are especially attractive. One feels that nature must have some story to tell in their queer markings if one but knew the key. Indeed, they look every bit as intelligible as the hieroglyphics of the Malay language. Forty-seven species of lichens were collected from the first subzone. The genera *Graphis*, *Pertusaria*, and *Sticta* are especially well represented.*

II. THE PODOCARPUS SUBZONE

(5,500–7,000 feet)

At an altitude of about 5,500 feet there is a pronounced change in the general appearance of the mountain forest. One realizes immediately that the woods have assumed a different dress. Everything is moss-covered (PLATE 16, FIG. 2). It is surprising with what suddenness the transformation takes place, and one wonders what differences in climatic factors can exist which produce so marked and so sudden a change between the region just left and that which lies beyond. So profuse is the moss drapery that one is inclined to term this the moss zone. Such a designation would, however, be inaccurate, as subsequent investigation will show.

* For a full account of the lichens and mosses collected in the Tjibodas forest see, The altitudinal distribution of lichens and mosses on Mt. Gedeh, Java, to be published in The Ecologist, January, 1924.

Here, in the second subzone, which we have just entered, the vegetation first really assumes the aspect of a tropical rain-forest. Lianes are more numerous. The undergrowth is less orderly (but by no means a "jungle," a word which is so often and so erroneously used to characterize tropical vegetation). Trees, rocks, and soil are moss-bedecked; and all is reeking wet, actual bogs being met with under foot.

FIG. 5. The monarch of the second subzone, *Podocarpus imbricatus*. The vine on the trunk some 20 feet from the ground is *Epipremnum pinnatum*. The native shown is Sapiin, the veteran plant collector of Tjibodas, who knows the Sundanese name of every seed-plant in these mountain forests.

Some plant forms of the first subzone are still abundant, but others are no longer seen and new forms take their place. The great rasamala is rare. *Podocarpus* is its successor (FIG. 5). This tree is the only conifer, in fact the only gymnosperm, indigenous to Mt. Gedeh. Three species of *Podocarpus* are to be found, *P. imbricata* (*P. cupressina*), *P. neriifolia*, and *P. amara*. While this genus extends into the two adjacent zones, especially the upper one, it is in this second subzone that it is most abundant and reaches its maximum size, fully 5 feet in diameter.

Podocarpus is the monarch of the second subzone, as was *Altingia* of the first, but other very large trees are also numerous. Especially fine is *Engelhardtia* (*E. serrata* and *E. spicata*). This big tree resembles the rasamala in size and shape, but its small lanceolate leaflets give to its lofty crown a different and lacy appearance. Another large tree common to this and the adjoining third subzone is *Schima Noronhae*, the "poespa" of the Javanese. Its good-sized, showy flowers are often seen sprinkling the ground with spots of white and yellow. The figs, oaks, and chestnuts

are still present and of great size. One repeatedly stops to admire the huge, tall, straight trunks of these superb giants of the mountain forest.

The small trees of the second subzone include *Meliosma nervosa*, *Elaeocarpus Acronodia* (and four other species of this genus), *Michelia montana* of the magnolia family, *Macropanax dispermum* of the Araliaceae, and *Pygeum latifolium*, a rosaceous tree (PLATE 16, FIG. 2).

Lianes are abundant. A conspicuous climber is the spiny *Fagara scandens*, one of the Rutaceae. The huge stubby spines tipped with sharp thorns give to this vine a vicious appearance. Isolated specimens of the climbing aroid *Epipremnum pinnatum* are met with.

Of epiphytes, the beautiful bird's nest fern, *Asplenium nidus*, still flourishes. The climbing pandanaceous epiphyte *Freycinetia* is first met here. The smaller epiphytes of this second subzone are chiefly orchids, ferns and mosses. An attractive orchid frequently seen in *Schoenorchis juncifolia*, with long, drooping stems and spindling, awl-shaped leaves, resembling a *Freycinetia* in miniature.

The forest floor assumes quite a different aspect in the second subzone owing to a greater abundance of light. Tropical forests are not as dark as most people who have never visited them believe; indeed, more light penetrates a tropical mountain rain-forest than enters a temperate closed deciduous forest, and a great deal more than reaches the ground in a Maine pine wood. The forest canopy of the second subzone is an open one. Trees are fewer than in the first subzone and the undergrowth flourishes proportionately better.

The rattan and Pinango palms are more numerous here at 6,000 feet than they were a thousand feet lower. Numerous species of Zingiberaceae are present. The two first subzone gingers, *Amomum* and *Phaeomeria solaris*, are still frequently met with. The coarse weed, *Cyrtandra repens*, with large, white, tubular flowers is widely spread in this as it is in the two adjoining subzones.

Terrestrial ferns grow in great luxuriance (PLATE 16, FIG. 2). *Polypodium nigrescens* is an interesting example which immediately attracts attention not only because of itshuge, coarse fronds but because of the exceedingly prominent sori which, when seen

on the dorsal side of the frond, are at first suspected of being insect galls. Another interesting species of fern is the epiphytic climber, *Oleandra neriiformis*, whose sprawling fronds reach far out from the tree trunk on which they grow somewhat in the manner of the epiphytic *Freycinetia*. The slender, hairy *Polypodium setigerum* is a graceful epiphytic fern. But to give a representative list of the ferns to be found in a Javan mountain forest would be a tremendous task.

Lycopodiums and selaginellas are likewise numerous. *Lycopodium Phlegmaria* is an interesting epiphytic species looking, with its tiny lanceolate leaves, more like a phanerogamous creeper than a member of the Pteridophyta.

The epiphytic growth of bryophytes is luxuriant. Every tree is moss-bedecked (PLATE 16, FIG. 2). The most abundant and typical festooning moss of the second subzone is *Papillaria fuscescens*, readily distinguished by its long, pendent streamers and small alternate "leaves" standing out at right angles to the stem. The moss *Mniodendron divaricatum* is a constant companion under foot from the first to the third subzone. Its little upright shoots, resembling miniature palms, are scattered over the ground and rocks along the trail until the highest altitudes are reached. Occurring epiphytically with the profuse growth is one of the many species of the liverwort *Plagiochila* (e.g., *P. Belangeriana*). A small terrestrial hepatic is *Fimbriaria Zollingeri*.

Very few lichens are to be found in this moss-covered zone, though a few gelatinous species are present. The absence of lichens is probably due, in part, to the moderate amount of light which penetrates the interior of this subzone, and, in part, to lack of space upon which to grow. They are crowded out by the widespread mossy covering.

As the upper limits of the second subzone are reached the giant specimens of *Podocarpus*, *Engelhardtia*, and *Schima* are no longer to be found. Only relatively small examples of these genera are now present (PLATE 16, FIG. 2). The average diameter of trees in the upper half of the second subzone is not over 12 inches as compared with diameters of 5 feet (*Podocarpus*) and 4 feet (*Engelhardtia*) in the first half of the zone.

As the border line between the second and third subzones is reached small bogs are not infrequent. Growing in these one

may find the pitcher plant, *Nepenthes melamphora*, with brilliant, purplish red, pendent pitchers. One wonders why a plant such as *Nepenthes* occurs in a locality so poor in insect life as the upper mountain regions of these forests. The pitcher of *Nepenthes* is a nicely planned mechanism for attracting, catching, and digesting insects, but of little use in the high altitudes of the third subzone where insect life is sparse. When the pitchers of *Nepenthes* are emptied they are found to contain but few and only small insects. As the plant thrives wonderfully well, an organic diet appears unnecessary. A further point of interest in connection with *Nepenthes* is the extreme polymorphism of the species. In the bogs where the plant is met with under foot in the third subzone, it is of a very compact form not rising over 8 inches from the ground. In other and drier regions of this zone *Nepenthes* occurs as a liane reaching a maximum length of 25 feet. The tendrils are extended leaf midribs. On the vines few, sometimes no, pitchers are formed. Numerous transitional forms occur between the two extreme types.

III. THE HERBACEOUS SUBZONE

(7,000–8,000 feet)

The transition from the second to the third subzone is gradual. The change in type of vegetation with increase in altitude is noticeable throughout the second subzone, the upper limits of which begin to assume third subzone characters. The epiphytic pandanaceous *Freycinetia* and the tall herb *Strobilanthes cernuus*, typical third subzone species, begin to appear in the upper limits of the second subzone, while second subzone genera, such as *Podocarpus* and the bird's nest fern, *Asplenium nidus*, last far into the third subzone.

The third subzone is open in character. The undergrowth, therefore, receives more light. Being at a high altitude the zone is frequently enveloped in clouds, and being, further, just below the gap between Gedeh and Pangerango, it is protected from wind. The zone is, consequently, very moist. Abundant light and moisture permit a luxuriant flora of tender herbs.

The trees of the third subzone are not distinctive. The open forest formation is made up of tree genera which are characteristic of the two neighboring zones. The second zone genera *Quercus* and *Schima* are abundant, and *Podocarpus*

occurs occasionally. The high altitude trees *Symplocos*, *Polyosma*, *Astronia*, and *Rapanea* first make their appearance here.

The most characteristic liane and epiphyte of the third subzone is the climbing *Freycinetia*. This grotesque plant, of which there are two species on Gedeh, is widely distributed. Sometimes only a single leafy shoot reaches far out into space. More often a number of sprawling branches hang over the trail like so many ferocious dragons blocking the way. Frequently the growth is so dense as to form a solid mass 15–20 feet in diameter high up on a tree trunk.

But it is the herbaceous undergrowth which characterizes the third subzone. Areas exist which are literally flower gardens. Several species of *Impatiens* are very abundant. The exquisite, pansy-like blossoms of these plants are found in delicate shades of pink and purple. The most common species is the pink-flowered *I. platypetala*. Frequently the purple-spotted pink flowers of *I. cyclocoma* are seen, and also the white, purple-centered blossoms of *I. hirsuta*. Less abundant is *I. choneeras* with a white flower, from which projects a short spur.

The liliaceous *Disporum chinense* (*D. pullum*), first cousin to the American Solomon's seal (*Polygonatum*), with dangling purple bells, is common in the undergrowth of this flowery zone. One of the commonest blossoms is the slender white, tubular flower of *Ophiorrhiza longiflora* (Rubiaceae). Begonias (e.g., *B. isoptera*) are very numerous, likewise the urticaceous herb *Elatostemma*. This latter plant is interesting because of the force with which the male flowers open. When a male bud (the species is monoecious) opens, the stamens fly back one at a time with great suddenness and force, scattering the pollen in a miniature cloud; indeed, the generic name tells the story, "stamen hurler."

Strobilanthes cernuus is a tall, succulent herb forming dense thickets in the second as well as the third subzone. The native name is "bobokuan" ("boku," articulation). It is a most unattractive, rank weed, but its flowers are exquisite little things. They are very small, shaped like tiny rose buds. The petals are white, pencilled along their outer edge with brilliant green.

The presence of one of the gingers, *Hedychium coronarium*, is first noted by its sweet perfume, scenting the air from far. *Curculigo curvata*, of the *Amaryllis* family, forms nearly pure

stands in the undergrowth. A large yellow raspberry, *Rubus alpestris*, tempts one to taste it only to find that it is frightfully sour.

The notch between the peaks of Gedeh and Pangerango, where the third subzone ends at an altitude of nearly 8,000 feet, is the

FIG. 6. The crown of an *Alsophila*.

home of one of the most exquisite of all tropical plants, the tree fern. The tree fern, although always associated with the tropics, is in reality subtropical. It is not found with such truly tropical plants as the cocoanut. On the contrary, it occurs at relatively high altitudes, where the temperature is moderate. As a group, the ferns are generally regarded as shade loving plants, but I am inclined to believe that it is not their apparent shade loving proclivities which determine the regions in which ferns in general

thrive, but rather their moisture requirements. The tree fern, for good development, requires *abundant* light as well as ample moisture and a cool temperature. Specimens found in the dark interior of the mountain rain-forests are invariably poor, and never have I seen a good stand of tree ferns but that the crowns were above all the surrounding vegetation, exposed to direct sunlight.

In the gulch at Kandang Badak, where the above mentioned climatic conditions prevail, there is an excellent growth of tree ferns. *Alsophila glauca* var. *densa* and *Cyathea orientalis* are the two characteristic tall species. The genus *Dicksonia*, which does not exceed a height of 10 feet as compared with a maximum of 50 feet for the other two genera, is represented by a single species, *D. Blumei*. When well developed the crown of the tree fern represents the most beautiful and delicate of all tropical foliage (FIG. 6).

Gleichenia, like the tree fern, requires ample light for its best development, but is an exception among ferns in that it thrives well in very dry soil. This fern is usually found in exposed sunny localities. Thus, it is very abundant in the open formation of the third subzone, where two species are common, a small, wiry one, *G. linearis*, and a large, coarse species, *G. volubilis*, which often sends out prostrate leafless shoots as much as 20 feet in length. Both form impenetrable thickets.

Mosses are much less abundant here in the third subzone than they were in the second. Their absence is due probably to the open, sunny, and therefore less moist nature of this region. Lichens, on the other hand, are more numerous. The cosmopolitan *Usnea* occurs in great abundance. This lichen is typically, the world over, a genus of high altitudes or latitudes.

The evidence that Mt. Gedeh is not a dead volcano is to be had along the trail in the third subzone, where two springs of steaming hot water gush forth and give rise to the brook "Tjipanas."* In the extremely hot water (about 130° F.)† of these springs there grows in great luxuriance a species of the

*"Tji" is a Malay prefix signifying "river". "Panas" the newcomer soon adds to his vocabulary; it means "hot".

† One often reads of higher temperatures of springs in which plants are growing, but the maximum temperature from a reliable source is not over 65° C. (150° F.).

alga *Oscillatoria*, which forms a jelly-like mass, rather resembling blubber, some two inches in thickness. Only the surface layer of this mass is green.

IV. THE VACCINIUM SUBZONE

(8,000–9,000 feet)

The climb to the crater of Mt. Gedeh or to the summit of Mt. Pangerango is made in about two hours from the cabin at Kandang Badak situated in the notch between the two peaks. The transition from the third to the fourth subzones is very abrupt on Gedeh and Pangerango. Tree ferns grow in great abundance almost to the very ridge at the notch where the third subzone ends. Above this point no tree fern is again met with. *Castanea*, *Quercus*, and *Engelhardtia*, among the big trees of the lower subzones, and persisting as smaller trees to the very edge of the fourth subzone, are now no longer seen. *Podocarpus* and *Schima Noronhae* are still present, but in reduced size, and greatly in the minority as compared with the other species. With change in kind there takes place a pronounced change in size and form of the trees. The maximum height here is not over sixty feet, and while some gnarled trunk may be more than a foot through, the average diameter of the trees is but 8 inches. Especially noticeable is the irregular shape of the trees of this zone (PLATE 17, FIGS. 1, 2). Whether the gnarled and twisted form of high altitude trees is due to the purely mechanical effect of wind or to trying physiological conditions such as high evaporation and low light intensity, under which the plants must grow, is still an unsettled question.

The characteristic genus of the fourth subzone is *Vaccinium*. In the upper half of the zone it forms pure stands (PLATE 17, FIG. 2), but in the lower half other typical high altitude trees are present. Among these are, *Polyosma ilicifolia*, *Astronia spectabilis*, *Symplocos sessilifolia*, *Weinmannia*, *Eurya japonica*, and *Rapanea avenis*, the last a typically high altitude tree resembling *Vaccinium*. The type of leaves of the last two genera is an instance of a very common characteristic of alpine plants, namely, the reduced size, leathery texture, and waxy surface of the leaves.

A tree of unusual interest, occurring near the summit of Mt. Sela, is the maple *Acer niveum*, which attains a maximum height of 100 feet. It is the only maple in Java.

Among the large lianes at this altitude are *Vaccinium varingiaefolium*, (*V. Teysmanni*), *Lonicera Loureiri*, and *Schefflera lutescens*.

The genus *Vaccinium* is remarkable because of extreme polymorphism; it exists as a tree, shrub, or liane, and may be either terrestrial or epiphytic. Five species occur on Mt. Gedeh: *V. varingiaefolium*, *V. coriaceum*, *V. lucidum*, *V. laurifolium*, and *V. ellipticum*. *V. varingiaefolium* is the most polymorphic of them all. It may be shrub, tree or liane and may grow terrestrially or epiphytically. As a liane it was formerly known as *V. Teysmanni*. In this form it is found in the lower half of the fourth subzone (PLATE 17, FIG. 1). In the upper section of the zone it occurs only as a tree to the almost complete exclusion of all other tree species. So far as I am aware botanical science is totally ignorant of the cause of such polymorphism. In the case of the pitcher plant *Nepenthes*, a conceivable factor is moisture, since the dwarf form is found in bogs and the liane form grows on dry soil. The same factor may possibly play a part in determining the form of *Vaccinium varingiaefolium*, since the liane is found only in the relatively moist lower half of the fourth subzone, while in the much drier upper section the species occurs as a tree. *Schefflera lutescens* may also occur as tree or liane.

The shrub *Rhododendron* is very abundant in this open, high altitude forest. There are three species: *R. retusum* with red flowers, *R. cilium* with large yellow flowers, and *R. javanicum* (the most common) with very large, orange-red flowers. This last species is especially interesting because of its presence here at 9,000 feet as a terrestrial shrub, although equally abundant as an epiphyte at Tjibodas 4,000 feet lower.

Herbs of the third subzone types are still numerous in this higher region. Especially noticeable is the blue color of flowers and fruits. Very prominent are the cobalt and pale green blues. The berries of the shrub *Lasianthus lucidus*, a rubiaceous plant, are of the former color, while the clusters of berries of *Dichroa febrifuga*, one of the Saxifragaceae, are a rich dark blue. The flowers of this plant are of a striking pale blue color. But the finest of the blue flowers is that of the orchid *Dendrobium Hasseltii*. Indeed, while I am inclined to give first place to *Impatiens platypetala* as the most beautiful of all the mountain

flowers, *Dendrobium Hasseltii* holds a close second place. This orchid is quite common in these high, foggy regions.

The parasite *Balanophora elongata* is a curious plant. The only aerial portion is the thick, short, flower-spike of brick-red color. *Balanophora* grows parasitically on the roots of *Vaccinium* and *Albizzia*, the latter a tree whose acquaintance we shall soon make. The subterranean portion of the parasite is a mixture of host and parasite tissue. This composite tissue is very hard and much resembles a piece of stag horn coral.

Terrestrial ferns are less numerous at this altitude. *Polystichum biaristatum* and *Plagiogyria glauca* are the most common. The coarse *Lomaria vestita* forms pure patches. *Nephrodium tuberosum* (*N. hirsutum*) is worthy of special note because of its large root tubercles. The epiphytic ferns are more numerous, especially species of *Polypodium*—for example, *P. obliquatum*, the smaller *P. hirtellum*, the climbing *P. rupestris*, and the smallest of polypodies, *P. cucullatum*. The thick, leathery, 15 inch leaves of *Elaphoglossum* one would hardly suspect as being those of a fern. Among the "filmy" ferns is the tiniest of all ferns, *Hymenophyllum paniculiflorum*, whose delicate lacy frond measures less than an inch in length. The lycopodium, *L. volubile*, is very prolific at this altitude.

Mosses are again exceedingly abundant in the lower half of the fourth subzone. Every tree and vine is covered with a thick mat of reeking wet moss (PLATE 17, FIG. 1). That is, there is here a second "moss zone." It is evident that "moss zone," which has been used by ecologists as a descriptive term in connection with mountain rain-forest regions, may be inaccurate.

The mosses of the fourth and second subzones differ strikingly in type. Those of the second subzone are mostly festooning types, loose in form, growing in long, pendent streamers. In the higher and more windy fourth subzone the mosses are all of a compact, tufted type, well adapted to hold water. A comparison of the two photographs, PLATE 16, FIG. 2, and PLATE 17, FIG. 1, will help visualize the pronounced difference in moss type of these two zones. An enumeration of genera would further emphasize the marked altitudinal distribution of mosses on Mt. Gedeh. Of thirty-two species collected and identified

no species and only two genera are common to both the second and the fourth subzones.

The fourth subzone extends to the summit of Pangerango with no pronounced change in type of vegetation, except at the very top where there is a small alpine plant community, barely more than an acre in area. The plants of this little alpine garden consist of shrubs, herbs, and grasses. Of shrubs there are dwarf *Vaccinium*, *Rapanea*, *Eurya*, and *Gaultheria*. The fruit of the bush *Vaccinium* resembles that of the American blueberry, and, though edible, is insipid.

Among the flowers of this small alpine pasture one of the prettiest is *Hypericum Leschenaultii*, much resembling the evening primrose of American pastures. Another reminder of fields at home is the buttercup, *Ranunculus javanicus*. Then there is a dandelion-like plant, *Sonchus asper*, the pale blue violet *Viola serpens*, the weed *Plantago major*, and a wild strawberry. Indeed, one could well imagine himself in a New England pasture. The small yellow, tubular flower of *Primula imperialis* deserves mention because it was singled out by the Dutch naturalist Junghuhn as "Queen among all the herbs which inhabit the summits of the mountains." So exalted a position for *Primula imperialis* is hardly deserved when *Impatiens platypetala* is near.

The view from the summit of Pangerango is one of the finest in all Java. Water-covered rice fields, one of the most charming and characteristic features of oriental tropical agriculture, lie close to the mountain base (FIG. 1), and beyond groves of cocoanut palms are distinguishable. Other mountain peaks stand silhouetted against the soft color of the morning sky. One is looking over the "Preanger Regent," the most picturesque province of all Java.

The trail to the crater of Mt. Gedeh differs from that to the summit of Mt. Pangerango, just described, in two striking particulars: first, the fourth subzone of Gedeh is divided into halves, distinguished by several prominent characteristics; and second, there is on Gedeh a fifth subzone of considerable area with a very distinctive flora.

The trees of the lower half of the fourth subzone on Gedeh are covered with a profuse growth of moss. Thick, water-soaked wads of moss pad every trunk. Suddenly, about midway in the zone, the moss covering disappears, and the trees are be-

decked with lichens instead. An idea of the completeness of the change can be had by comparing the photographs on PLATE 17.

Both sections of this high altitude subzone receive ample precipitation, but the upper half is considerably more open in character and more wind-swept. The complete absence of mosses in the upper part of the zone is probably due to the effect of dessicating winds at the higher altitude, where even compact, tufted mosses would be unable to retain moisture. The presence of lichens in the upper half of the zone and their absence in the lower section is possibly due, in part, to better illumination and, in part, to lack of mosses in the upper region. Certain it is that the profuse moss covering of the lower half of the subzone leaves no spot where a lichen might subsist.

Having reached a second lichen flora it is instructive to compare the lichens found at the higher altitude with those of the first subzone at Tjibodas. Of sixty-seven species of lichens collected none are common to both the first and the fourth subzones, with one possible exception. Among the fourth subzone lichens are four species of *Parmelia*, a *Phaeographis*, and a *Cetraria* (*Nephromopsis*); the latter is the most common lichen at this altitude, growing luxuriantly in large, fluffy, cream-colored patches.

V. THE EDELWEISS SUBZONE

(9,400 feet)

On emerging from the last stand of trees which ends the fourth subzone on Mt. Gedeh (PLATE 17, FIG. 2), quite a different type of vegetation confronts one. Plant life is sparse. Only one genus of tree exists and it averages not over 12 feet in height. The two characteristic plants of the alpine flora of the fifth subzone are the shrub, *Anaphalis javanica* (one of the Compositae), and the small tree *Albizzia montana* (FIG. 7). The former, with flowers of soft grayish-white color, is the edelweiss of Java. Other plants typical of this open alpine formation on the lava floor of the old crater of Gedeh are the crinkly leaved tree-shrub *Myrica javanica*, the dwarf *Rhododendron*, the dwarf *Vaccinium varingiaefolium*, and the shrub *Gaultheria leucocarpa* with tiny pale pink flowers, white berries, and leaves of a pronounced and very agreeable winter-

green odor when crushed. The leaves of *Gaultheria* exhibit a characteristic of alpine plants, standing perpendicularly to and closely surrounding the stem. Some few ferns are still found at this altitude, and lycopodiums are quite abundant, for example, *L. gedeanum*.

This fifth subzone is essentially the last distinctive vegetative region on Mt. Gedeh. There is, however, a small area immediately surrounding the present crater of Gedeh and extending a short distance down into the crater, which can be regarded as an upper subdivision of the fifth subzone, for here the plants

FIG. 7. The Javanese edelweiss, *Anaphalis javanica*. The foliage in the right background is that of a young *Albizzia montana*. The tiny leaves in the left center background are *Myrica javanica*. The shrubs in front of the edelweiss, center and left, are dwarf *Vaccinium varingiaefolium*.

are fewer in number and all greatly dwarfed. The vegetation which is scattered over this waste surface of lava consists of isolated and small stunted specimens of edelweiss, *Vaccinium*, *Rhododendron*, *Myrica*, and another *Gaultheria* species, *G. fragrantissima*.

Of the multifarious ferns ubiquitously present from the first to the fifth subzone, only one, a dwarf variety of the remarkably adaptable species, *Polypodium Feei*, remains to occupy the rocky lava floor of the old crater of Gedeh. Representatives of this genus are found in every zone from an altitude of 4,600 to one of 9,400 feet.

Within the confines of the huge old crater of Gedeh there occurs, in addition to the present semi-active crater, another small, secondary but extinct crater which harbors a flora all its own. This little plant community owes its existence to its well protected situation and to the abundance of water which drains into it from the summit of Gedeh. Here, on the bottom of the small crater pit, there is a rank growth of the sedge, *Gahnia javanica*, scattered in the form of huge hillocks.

There is probably no tropical mountain rain-forest in the world which possesses a greater wealth of plant life than that at Tjibodas on Mt. Gedeh. I can imagine no walk more delightful and full of interest than from the laboratory at Tjibodas to the crater of Gedeh and the summit of Pangerango. The Tjibodas virgin forest, as compared with other similar regions, presents an outstanding diversity of vegetative types. While, in certain respects, the flora of Java is surpassed by that of Ceylon, and by the vegetation in certain parts of India, in neither case, nor anywhere in the tropics, so far as my knowledge extends, is there within so limited and so readily accessible a region such a multiplicity of genera and such extremes of plant forms—a thousand or more species—from bananas to edelweiss.

I wish to express my indebtedness to Dr. C. A. Backer of the Buitenzorg Herbarium for his kindness in identifying many plants collected by me. Without Dr. Backer's generous assistance so complete a description of the vegetative zones as is here given would not have been possible.

Description of plates 15-17

PLATE 15

FIG. 1 (at left). The grass trees, *Xanthorrhoea Preissii*, in the Tjibodas Garden. These liliaceous trees are natives of the Australian savannahs.

FIG. 2 (at right). The stately bird's nest fern, *Asplenium nidus*.

PLATE 16

FIG. 1 (at left). An *Asplenium nidus* suspended at the end of a slender branch. Note other epiphytic ferns growing out of the base of the *Asplenium*.

FIG. 2 (at right). The upper limits of the second subzone. The larger trees (the maximum size at this altitude) are *Engelhardtia*. The smaller trees are *Pygeum*, *Elaeocarpus*, *Meliosma*, and *Schefflera*. *Disporum* is abundant on the forest floor (lower right corner). The terrestrial ferns are chiefly *Dryopteris heterocarpa*. *Asplenium caudatum* is the (epiphytic) fern with long slender fronds to the right of the coolie. One of the most abundant mosses in the profuse epiphytic moss growth is *Papillaria fuscescens*, the typical festooning moss of the second subzone.

PLATE 17

FIG. 1 (above). The moss section of the fourth subzone. The largest tree (left center) is *Schima Noronhae*. The smaller trees are *Polyosma*, *Symplocos*, and *Rapanea*. The liane is *Vaccinium varingiaefolium* (*V. Teysmanni*). Few *Vaccinium* trees are to be found in the lower half of this zone. Note the thick padding of moss. The moss covering the large tree is *Sematophyllum pinnatum*. Suspended from the liane are the tiny epiphytic ferns, *Polypodium cucullatum* and *Hymenophyllum paniculiflorum*.

FIG. 2 (below). The lichen section of the fourth subzone. Note the complete absence of moss. This is the last stand of trees on Mt. Gedeh. The trees are almost entirely *Vaccinium varingiaefolium*, the same species which grows as a liane a few hundred feet lower (see FIG. 1).

SEIFRIZ: PLANTS ON MT. GEDEH, JAVA

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SEIFRIZ: PLANTS ON MT. GEDEH, JAVA

Studies in tropical Ascomycetes—II. An interesting Xylaria from Porto Rico

FRED J. SEAVER

(WITH PLATE 18)

During a recent collecting trip to Porto Rico* the writer had the opportunity of visiting one of the most interesting and fruitful collecting grounds for fungi to be found on the island, the Luquillo Mountains. This trip was made possible through the efforts of Mr. E. M. Bruner, Forester of Porto Rico, who placed at our disposal the Forest Ranger's cabins, located at an elevation of about 1200 feet. This camp consisted of two cabins, one of boards with metal roof and the other a rough building with thatched roof. The cabins were provided with cots, utensils, and charcoal stoves for cooking. Mr. Bruner acted as host and supervised the house-keeping activities during our stay here. The party consisted of Dr. and Mrs. Britton, Mr. Bruner, Professor Dale of the University of Porto Rico, and the writer.

The trip from San Juan to Mameyes was made by automobile and the ascent from this point to the Forester's camp on foot or by horse. Arriving at the camp soon after noon on Friday, February 23, the remainder of the afternoon was spent in the vicinity of the camp site.

Saturday, February 24, an expedition was planned to the top of El Yunque, for a long time supposed to be the highest peak in Porto Rico but now known to be exceeded by several others. The ascent was made much easier by reason of the trail of broken stone which had been constructed under the supervision of Mr. Bruner for a greater part of the distance. Soon after the expedition started, it began to rain, as it nearly always does at this elevation, and a slow drizzle continued during the remainder of the day, making the climb at places very slippery and disagreeable. We succeeded, however, in reaching the top

* Jour. of the New York Bot. Gard. **25**: 99–101. 1923.

at an elevation of about 3500 feet. Here the soil and atmosphere were saturated so much so that it was impossible to find a dry place where one could sit to rest or eat. The trunks of the trees and even the leaves were loaded with mosses and hepatics, and there seemed to be scarcely room for a fungus to grow, although a number of specimens of *Aschersonia* in fruit (*Hypocrella*) were found and in some abundance.

The view, which must be remarkable under favorable conditions, was entirely missed by us on account of the atmospheric conditions. In spite of the fact that we were under the tropical sun, had it not been obscured by the clouds and fog, a cold chill wind swept over the mountain top which compelled us to look for a sheltered spot where we could eat our lunch in comparative comfort.

Not finding the conditions especially favorable for mycological collecting at this elevation the writer preceded the party down the trail in order to have time to hunt leisurely for things of a mycological nature. Many interesting collections were made, most of which have not been studied critically. One which was of more than usual interest was a species of *Xylaria* which is made the subject of the present paper. These specimens were found opposite the overhanging rock about midway between the summit and the Forester's cabin to the left of the trail going down.

On account of the density of the forest and the general gloominess of the day it was difficult to detect the presence of minute fungi. However, on picking up what appeared to be a dead stick a seed the size of an ordinary marble was found attached to its base. On closer examination the object, which proved to be a large fungus, was at first thought to be a fine *Cordyceps*. It finally turned out to be a *Xylaria*. On further search other plants were found until fifty or a hundred specimens had been collected, each growing from a seed of what proved to be that of the mountain palm, *Euterpe globosa* Gaert. A number of fungi, such as certain species of *Sclerotinia*, grow exclusively on seeds. Also a number of species of *Cordyceps* grow on underground fungi which have much the same general appearance, but so far as the experience of the writer has gone this is the only species of *Xylaria* encountered which has the general appearance of a *Cordyceps* with the habitat of the *Sclerotinia*.

The species has been found only in the one locality in Porto Rico. The host on which the fungus preys, however, occurs from Cuba to Hispaniola and Porto Rico and in the Lesser Antilles from Saba to Grenada. Assuming that the fungus is restricted to the one host, as it seems to be, its possible range of distribution then is as indicated above. The only economic bearing which the fungus could have is in connection with the destruction of the seeds of the host. How important this can be cannot be stated.

Our material from Porto Rico agrees quite closely, so far as we can judge from the description, with *Xylaria palmicola* Winter,* described from Brazil. No specimens of the South American species have been seen and the host of that species is not named. The fact that the host of the Porto Rican species does not occur in South America, so far as we know, leads the writer to regard ours as distinct. The species is dedicated to Mr. Bruner and a description appended.

Xylaria Bruneriana, sp. nov.

Stromata growing upon and their mycelium filling the seeds of their host and apparently absorbing the greater part of their contents, reaching a height of 10–12 cm. and a diameter of 2–4 mm., consisting of a sterile stem and a fertile club-shaped head, the latter comprising about one fourth of the whole stroma and considerably thicker; stem cylindrical, slightly tapering above and becoming twisted (especially when dried); perithecia subglobose, about 500 μ in diameter; asci subcylindric, eight-spored, reaching a length of 140 μ, the ascus wall being very transparent and often almost invisible; spores unequal-sided, rather sharp pointed, 16 × 6–7 μ, often slightly flattened, hyaline, becoming dark brown.

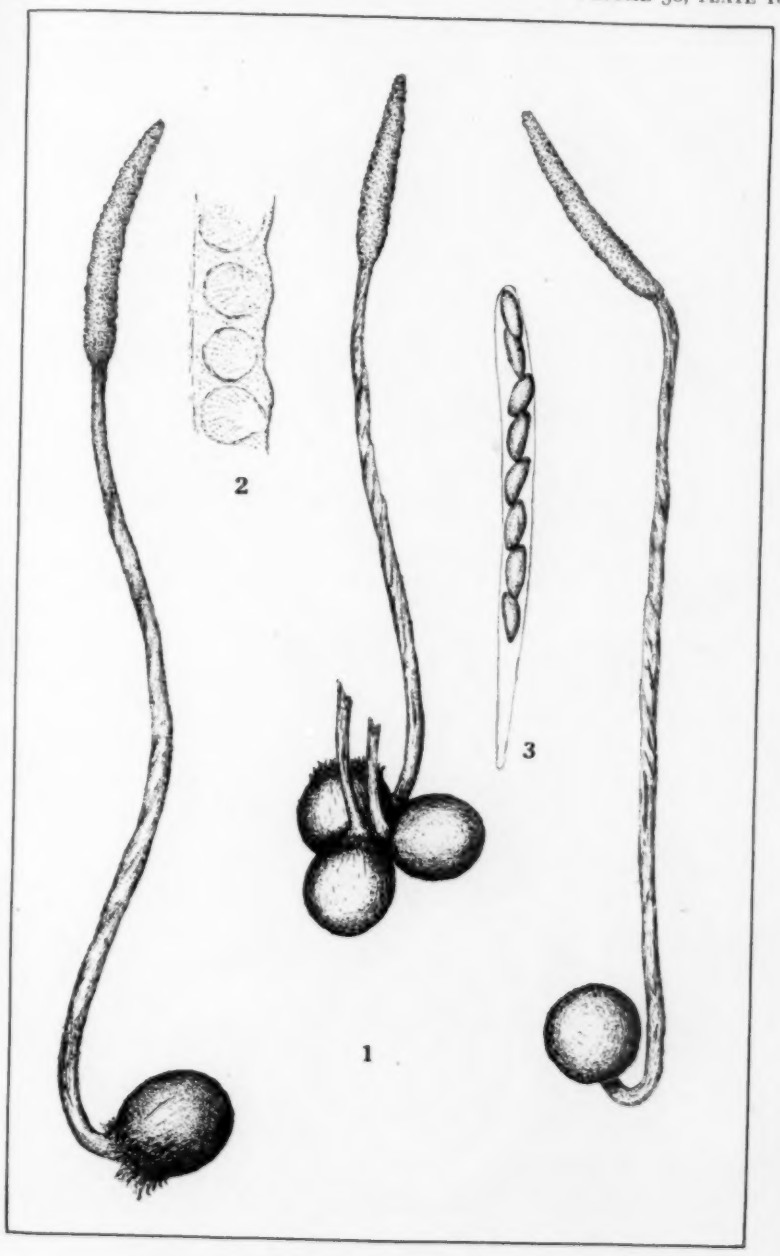
On fallen seeds of the mountain palm, *Euterpe globosa* Gaert., El Yunque, February 24, 1923.

* Grevillea **15**: 89. 1887.

Description of plate 18

XYLARIA BRUNERIANA Seaver

FIG. 1. Several plants about natural size.
FIG. 2. Diagram of a section of the fertile head.
FIG. 3. Ascus with spores, drawn with the aid of the camera lucida.



XYLARIA BRUNERIANA SEAVER

INDEX TO AMERICAN BOTANICAL LITERATURE
1920-1922

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in the broadest sense.

Reviews, and papers that relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, cr laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

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